

Gamma-ray Astroparticle Physics in Latin America

Regional Contributions, Leadership & Research Activities

Claudio Dib (UTFSM), Ibrahim Torres (INAOE)

Gamma-rays Pillar — LatAm Lead

CLAF-CNRS IRN Hybrid Workshop · Paris, April 15, 2026

CLAF-CNRS Latin-American Astroparticle Physics Research Network



The Four Experiments at a Glance

French pillar talks covered status & CNRS contributions — this talk focuses on Latin America.

CTAO-South

Imaging Atmospheric Cherenkov · 20 GeV – 300 TeV

 **Paranal Observatory, Chile**

Under construction · Groundbreaking Dec 2025

64 telescopes (alpha config) · First telescopes late 2026

SWGO

Water Cherenkov Array · 100 GeV – PeV scale

 **Pampa La Bola, Chile · 4,770 m a.s.l.**

Site selected Aug 2024 · Construction 2026

~1 km² · Dual-layer WCD · 319-author science white paper 2025

HAWC

Water Cherenkov Array · 100 GeV – 100 TeV

 **Sierra Negra, México · 4,100 m a.s.l.**

Operational since 2015 · > 10 years of data

300 WCDs + 345 outriggers · 24/7 full-sky monitoring

ALPACA

Air Shower + Muon Detector Array · 10 TeV – 1 PeV

 **Chacaltaya, Bolivia · 4,740 m a.s.l.**

Prototype ALPAQUITA operational since 2023

First Southern Hemisphere sub-PeV gamma-ray array

CTAO-South

Cherenkov Telescope Array Observatory — Paranal, Chile

LatAm: governance leadership + critical hardware production

GOVERNANCE & LEADERSHIP

Vitor de Souza

Chair, CTAO Consortium Board
IFSC-USP, Brazil

Manuela Vecchi

Physics Coordinator, Consortium
Formerly IFSC-USP, Brazil

Ulisses Barres de Almeida

Multi-band Coord. / Board member
CBPF, Brazil

Brazil holds 3 seats on the CTAO Consortium Board

HARDWARE DELIVERABLES

MST Camera Support Quadrupod

Brazil — USP/UFABC + Orbital Engenharia

16 m, 4.5-ton carbon-steel structure · ~25 units planned
Beat competing French proposal · R\$5M (FAPESP + Araucária)

ASTRI Mini-Array SSTs (3 of 9 units)

Brazil — IAG-USP (Dal Pino, PI)

CTA SST precursor installed at Tenerife · €3M FAPESP
Brazil co-builds first CTAO telescopes on Chilean soil

Chile — Host Country (ESO / ANID)

10% observing time reserved for Chilean scientists

ANID cooperation agreement 2018
Groundbreaking Dec 2025 · ANID Director present

SCIENCE ANALYSIS CONTRIBUTIONS FROM LATIN AMERICA

Galactic Centre Dark Matter Programme

Aion Viana (IFSC-USP, Brazil) · 2017–2023

Coordinated the entire CTAO Galactic Centre / inner Galaxy science working group.

Flagship dark-matter sensitivity study: JCAP 2021, arXiv:2007.16129

First comprehensive DM signal predictions for the southern array

MHD Particle Acceleration in AGN Jets

Elisabete de Gouveia Dal Pino (IAG-USP, Brazil) · Ongoing

MHD simulations of relativistic jet particle acceleration via magnetic reconnection

Direct input to CTAO AGN science preparation

Fundamental for interpreting future blazar & radio-galaxy observations

Time-variations in AGNs

Walter Max-Moerbeck (Dept Astronomy, U de Chile, Chile) · Ongoing

part of de AGN KSP

Extragalactic studies and Redshift Task Force

Sub-GeV Dark Matter via Cosmic-Ray Scattering

Igor Reis & Aion Viana (IFSC-USP, Brazil) · 2024

Novel method probing sub-GeV DM through CR–DM scattering observable by CTAO

arXiv:2403.09343, JCAP 2024

Opens a new DM mass window inaccessible by conventional searches

Blazar Variability & Multi-messenger Astrophysics

Ulisses Barres de Almeida (CBPF, Brazil) · Ongoing

Multi-wavelength coordination of blazars and AGN monitoring campaigns

LMulti-Messenger follow-up analyses with CTAO data

Member of LST Collaboration; active in transient science group

Galactic Center particle acceleration and emission models

Mario Riquelme (FCFM- U de Chile, Chile) -Ongoing

SWGGO

*Southern Wide-field Gamma-ray Observatory — Pampa La Bola, Chile ·
4,770 m a.s.l*

LatAm: co-leadership + hardware in 5 countries · construction begins 2026

5

LatAm countries
on Steering Committee

~40

LatAm
institutes

~100

LatAm scientists
($\frac{1}{3}$ of collaboration)

2026

Construction
start target

HARDWARE & LEADERSHIP BY COUNTRY

Brazil (CBPF)

Vice-Spokesperson: Ulisses Barres de Almeida
Patented rotomolded plastic tanks for outer PeV array · Manufactured in Rio Grande do Sul. **Two plastic tanks already sent to Chile.**

Mexico (INAOE)

WCD prototype assembled & tested at HAWC site (4,100m)
Transferring 10 years of water-Cherenkov operational expertise to SWGO

Peru (CONIDA / PUCP)

Full-scale WCD prototype deployed at 4,800m altitude · Imata candidate site
Published tank design · PoS ICRC2023

Chile (UTFSM / CCTVal)

Host country negotiations · Claudio Dib — LatAm Pillar co-lead
Site environmental characterization at Pampa La Bola (selected 2024)
Local Manager hired by CCTVal to plan for first installations (Pathfinder)
Statement of Interest in SWGO signed by 11 Chilean universities

Argentina (ITeDA / IAFE)

CR anisotropy & composition expertise (Pierre Auger legacy)
Adrian Rovero — SWGO Steering Committee member

INAOE is Mexico's lead institute in SWGO · direct operational heritage from HAWC · Gamma-rays Pillar LatAm co-lead in the CLAF-CNRS IRN

CONTRIBUTIONS TO SWGO

Water-Cherenkov prototype R&D

WCD assembled & tested at Sierra Negra (4,100 m) — direct transfer of 10+ years of HAWC operational expertise to SWGO design

Steering Committee representation

Ibrahim Torres — SWGO Steering Committee member (Mexico seat)

Science programme

Gamma-ray source population studies · Galactic plane survey · CR · AGN variability monitoring with SWGO wide-field coverage

SOME HAWC SCIENCE FROM MEXICAN GROUPS

GRB follow-up programme

González et al. (IA-UNAM) · GRB 221009A spectral analysis, ApJ 944 (2023)

Dark matter Galactic Centre searches

arXiv:2509.06210 (2025) · strongest water-Cherenkov DM constraints at multi-TeV

TeV solar gamma-ray detection (6.3σ)

PRL 131, 051201 (2023) · novel probe of solar magnetic structure

All-particle CR spectrum 10–1000 TeV

Arteaga-Velázquez (UMSNH) · Astropart. Phys. 167 (2025)

HAWC

*High-Altitude Water Cherenkov Observatory — Sierra Negra, México ·
4,100 m a.s.l*

Operational since 2015 · Mexico as co-equal scientific partner

~14 Mexican institutions ≈ half the HAWC collaboration · SECIHTI (CONAHCYT) Laboratorio Nacional HAWC

HARDWARE & INFRASTRUCTURE BUILT BY MEXICO

BUAP/UAEH

Ultra-pure water treatment plants

55 million litres · Environmental Monitoring System · filter systems & water quality control

IF/IA-UNAM

Detector instrumentation & PMTs

PMT testing, calibration & QC across 300 main tanks · detector assembly coordination

BUAP / INAOE

140 km fibre-optic network

Connects HAWC → INAOE → National Supercomputing Lab → Mexico City · ~2 TB/day data

INAOE

Host institution & site management

Alberto Carramiñana — Mexican spokesperson · site permit & logistics with INAOE/BUAP, Ibrahim Torres - Site Manager

RMxAA 2025

The first 10 years of the HAWC Gamma-Ray Observatory: science results*HAWC Collaboration · Rev. Mex. Astr. Astrof. Vol. 61 Issue 3 (2025)*

Comprehensive decade review: 90+ peer-reviewed publications spanning TeV source surveys, particle physics, transients, and cosmic-ray physics

ApJ 2025

Longtime Monitoring of TeV Radio Galaxies with HAWC*HAWC Collaboration · ApJ 994, 191 (2025)*7.5-yr monitoring of M87, NGC 1275, 3C 264 & IC 310 — M87 detected at $>5\sigma$ with evidence of enhanced emission and long-term variability from 2019

PDU 2026

Constraints on axion-like particles from ultra-high-energy observations of M87 with HAWC*HAWC Collaboration · Physics of the Dark Universe, Vol. 52, 102260 (2026)*7.5 yr of HAWC data on M87 sets competitive ALP constraints — excludes masses $\sim 10^{-8}$ – 10^{-6} eV for couplings above 5×10^{-12} GeV $^{-1}$

AP 2025

All-particle cosmic-ray spectrum 10 TeV – 1 PeV*Arteaga-Velázquez et al. (UMSNH) · Astropart. Phys. 167 (2025)*

LatAm-first-authored measurement bridging direct and indirect CR detection

Led by UMSNH (Morelia) group — a flagship Mexican science output

4HWC 2026

Fourth HAWC Source Catalog — 85 VHE gamma-ray sources*HAWC Collaboration · arXiv:2602.00263 (Feb 2026)*

Most complete TeV sky map from a wide-field ground observatory

11 new unidentified sources · 22 with no LHAASO counterpart

ALPACA

Andes Large-area PArticle detector — Chacaltaya, Bolivia · 4,740 m a.s.l

Bolivia's 75-year cosmic-ray legacy continues · Bolivia + Japan + Mexico

75+ year legacy: César Lattes (Brazil) discovered the pion at Chacaltaya in 1947 · Brazil–Japan collaboration 1950s · BASJE ran 1962–2015 (longest-running international CR experiment) · ALPACA is the direct scientific heir

BOLIVIA (IIF-UMSA) — FOUNDRING SCIENTIFIC PARTNER

Not just a site host — a co-lead with genuine scientific responsibility

- Leads ALL on-site construction & maintenance of ALPAQUITA's 97 detectors
- Calibration runs every ~20 days
- Geant4 simulations of PMT reflective structures (Cruz Carpio, UMSA student)
- Also operates LAGO & MATHUSLA detectors at Chacaltaya
- Lead: M. Subieta Vásquez (PhD Turin, former CERN researcher)

MEXICO (UdG) — ANALYTICAL LEADERSHIP

γ /hadron discrimination via muon lateral distribution

Eduardo de la Fuente (UdG) · Exp. Astronomy 2025

+18% sensitivity improvement at 60–100 TeV

Detection of May 2024 Forbush decrease (70–1000 GV)

M. Anzorena (UdG/ICRR) · arXiv:2601.08154

First independent physics result from ALPAQUITA

Validation: Moon shadow -10σ (angular res. $\sim 0.9^\circ$) · Sun shadow -5σ (Solar Cycle 25 max)

The Regional Ecosystem

Connecting the Dots Across Experiments

LatAm groups are not 4 isolated teams — a maturing ecosystem connects them and transfers technology across experiments:

LAGO

Latin American Giant Observatory

Water-Cherenkov network across 9 countries ·
90+ scientists from 25+ institutions
Seedbed for HAWC & SWGO expertise
FAIR-compliant open data pipeline
(EOSC-Synergy)
arXiv:2601.10893 — Jan 2026

CLAF + LASF4RI

Strategic Planning & Coordination

CLAF Astroparticle Unit created 2022–23
Ulisses Barres (SWGO Vice-Spokesperson) is
now CLAF Director
LASF4RI identifies gamma-ray astronomy as
continental priority
III LASF4RI Symposium — Aug 2024,
ICTP-SAIFR
LAA-HECAP mobility programme active

Training Pipeline

Schools, Networks & Next Generation

1st CLAF/ICTP-SAIFR LatAm Astroparticle
Physics School
(Aug 2025, São Paulo) — CTAO & SWGO tools
HAWC: 50+ PhD/MSc students since 2007
LA-CoNGA Physics (ERASMUS+): WCD labs at 4
LatAm universities
ICHEP 2026 in Natal, Brazil — first ever in
LatAm

Water-Cherenkov technology flows HAWC → SWGO and ALPACA, carried by the same Latin American scientists

LatAm Participation & Research Synergies

Who does what — and where collaboration can grow

Country	CTAO-South	SWG0	HAWC	ALPACA
Brazil	Governance + Board	Co-Lead Hardware	—	Historical Legacy
México	—	SC + WCD HW	Lead ~50% groups	Analysis UdG
Chile	Host Country	Host + Co-Lead	—	—
Argentina	—	SC + CR Science	—	—
Peru	—	WCD Hardware	—	—
Bolivia	—	—	—	Lead Site

Lead role
 Active participation
 No participation

Water-Cherenkov Technology Transfer

HAWC operational expertise (Mexico) flows to SWGO detector design (MX, BR, PE) and ALPACA analysis (MX, BO) — shared engineering knowledge across 3 experiments

Dark Matter Science Programme

CTAO (Brazil: GC DM searches) ↔ HAWC (Mexico: multi-TeV constraints) ↔ SWGO (BR+MX)
Complementary sensitivity from 100 GeV to 100 TeV — natural joint IRN science project

Multi-Messenger & Transient Astronomy

HAWC/SWGO real-time alerts → CTAO rapid follow-up (GRBs, AGN flares, neutrino counterparts)
Mexican + Brazilian groups already active in GRB & blazar programs — ready to scale up

International Research Network opportunity: multi-experiment student exchanges + joint analysis projects across the WCD (HAWC→SWG0→ALPACA) and IACT (CTAO) communities

Summary & Outlook

Experiment	LatAm Role	Key Highlight
CTAO-South	Governance leadership + critical hardware	Vitor de Souza chairs CTAO Board · Brazil builds MST quadrupods · €3M in ASTRI SSTs
SWG0	Co-leadership + hardware in 5 countries	Barres Vice-Spokesperson · 5 SC seats · Rotomolded tanks (BR) · WCD prototypes (PE, MX)
HAWC	Half the collaboration + landmark science	Nature 2024 · GC PeVatron >100 TeV · Solar TeV · All-particle CR spectrum · 50+ students
ALPACA	Founding scientific partner (Bolivia + Mexico)	75-yr Chacaltaya legacy · +18% sensitivity gain (UdG) · First Forbush decrease

UPCOMING MILESTONES

CTAO-South first telescopes operational — late 2026 · NectarCAM delivery 2026

SWG0-Pathfinder deployment at Pampa La Bola — 2026 · SWGO-A construction start

ICHEP 2026 in Natal, Brazil — July 30–August 5 · First ICHEP ever in Latin America

From site hosts to scientific leaders — Latin America shapes the future of Southern Hemisphere gamma-ray astronomy